

HEAT OF HYDRATION APPARATUS



Year of Purchase:

Cost:

About Calorimetry

Calorimetry measures the heat generated from a chemical reaction. For building materials scientists and cement and concrete professionals, calorimetry is a useful tool to study the properties of cementitious materials. The heat outflow measured by a calorimeter tracks the hydration reactions of cement, which gives visibility into the behavior of concrete or mortar in a way that a simple set time or compressive strength test could not. The timing and shape of the temperature curve obtained through calorimetry is an indicator of relative performance of cementitious mixes, and of potential adverse interactions among materials used in the mix. In adiabatic calorimetry, concrete samples are in a perfectly insulated environment, simulating hydration at the core of a mass concrete application. In an isothermal calorimeter, the outside temperature is maintained constant to simulate different curing temperatures. The tight temperature control further allows for excellent repeatability. The Calmetrix team has decades of real life experience with calorimeters used at concrete production sites and in research laboratories. We not only understand calorimetry, but also have a deep knowledge of cement chemistry and a genuine understanding of the industry.

Description

I-Cal 4000 HPC ("High Precision Calorimeter") is a 4-channel Isothermal Calorimeter. Like all Calmetrix I-Cal isothermal calorimeter models, I-Cal 4000 HPC features a sample size of up to 125ml, which can be used for multiple applications, including R&D and Investigative work on cement, mortar and concrete properties as well as daily QC needs in cement and concrete production. Variable reference cells make I-Cal 4000 HPC a versatile equipment, making it possible to test cement, mortar and real concrete, or other materials of various types and sample sizes. I-Cal 4000 HPC's tight temperature control is useable for tests lasting up to 28 days.

I-Cal 4000 HPC is fully compliant with ASTM C1679, ASTM C1702, ASTM C563 and EN 196-11.

The ambient temperature around the samples is computer-controlled by Calmetrix's software interface, with precision sensors measuring the heat flow generated by the cement hydration reaction. But the I-Cal HPC line of calorimeters distinguishes itself by its clever design to minimize sensitivity to outside conditions. This means more consistent results, but also a robust performance even in a non-air conditioned environment, a definitive benefit in terms of reproducibility, and cost savings for field laboratories or rooms that are not tightly air-conditioned.

Applications:

I-Cal 4000 HPC is well adapted for applications in R&D and Investigative work on cement and concrete properties, as well as daily QC needs in cement and concrete production. Typical uses are:

- Heat of hydration measurement as per ASTM C1702
- Detection of potential material incompatibility (between cement and admixtures, etc.)
- Admixture formulation
- Shotcrete accelerator studies
- sulfate optimization
- Sensitivity tests on variations in admixture or other material content
- Estimation of compressive strength using heat of hydration curves
- Determination of activation energy for thermal crack prediction
- Sensitivity tests on temperature variations
- mix design optimization and statistical performance analysis
- Test temperatures of more than 50 °C (up to 70 °C), e.g. for studies of delayed ettringite formation
- Characterization of supplementary cementitious materials.

Typical users of I-Cal Ultra are laboratories for advanced research of cement and other hydraulic materials among Cement Producers, Universities, and Specialty Chemicals companies.

I-Cal 4000 HPC:

I-Cal 4000 HPC is the right isothermal calorimeter for experiments that have the following characteristics:

- curing at any temperature, and up to 70 °C when needed
- short and long term test durations, including testing of up to 28 days
- Heat of hydration testing as per ASTM C1702

CalCommander software for Cement and Concrete calorimetry

The CalCommander software was designed for the needs of cement & concrete scientists and quality control professionals, giving them the means needs to innovate faster and streamline everyday tasks by cutting back on traditional

physical performance testing. CalCommander can be used to predict or model compressive strength gain and setting times, and even provide an optimum sulfate addition level, thereby saving time and costs associated with other testing methods.

CalCommander for Isothermal calorimeters

Works with all Calmetrix I-Cal models

I-Cal Logger



I-Cal Logger operates your calorimetry equipment. You can start/stop logging and capture relevant data for your experiment that will be stored along with the heat curve. I-Cal Logger logs and displays Power, Energy as absolute values, or by unit weight of cement or mass of cementitious material. You can also create interim reports while logging data.

I-Cal Reports



I-Cal Reports is used to retrieve curves from past experiments, zoom in on parts of the curve for more detailed analysis, create comprehensive reports or save graphs as images. Graphs can be shown as Power, Energy or Power and Energy normalized by unit weight of cement or cementitious material. You can also export data into a format compatible with spreadsheet applications such as Microsoft Excel or OpenOffice.

I-Cal Set



I-Cal Set lets you infer setting times directly from calorimetry curves. Based on the proven "fractions" method, it is quick to set up and easy to use. Users can create correlation files for given mix designs to fine tune results. The software also provides a graphic representation of the window of finishability for each mix.

I-Cal Strength



I-Cal Strength can be used in two ways:

a. predict compressive strength in the absence of any physical testing. I-Cal Strength helps establish the correlation between a given mix's calorimetry curve and compressive strength values. This correlation is then used to predict compressive strength every time testing with the same mix design is done.

b. make physical compressive strength testing for a few curing ages and use the calorimetry curve to estimate strength at other curing ages. This helps to reduce the cost burden of physical testing, or to get values of compressive strength at times when technicians are not available for physical testing, i.e. at night or on week-ends.

I-Cal AE



Activation energy is often used in maturity-based predictions to infer propensity of cracking or compressive strength gain. I-Cal AE determines the activation energy of a predominantly portland cement-based mix, or a high volume pozzolan mix, or even alkali-activated systems such as geopolymers.

I-Cal AE also draws the Arrhenius plot, which quickly characterizes the behavior of a specific mix and its sensitivity to temperature variations.

I-Cal HoH



I-Cal HoH is used to determine the exact value of heat of hydration of a cement or cementitious system. The user has the option to use input fields, calculations and reporting that are conveniently designed for use with ASTM C1702.

Note: I-Cal HoH should only be used with the I-Cal HPC line of calorimeters.

I-Cal SO3



I-Cal SO3 is an application that uses calorimetry curves for sulfate optimization of cement. It bases itself on ASTM C563, using heat of hydration as a proxy for compressive strength.

I-Cal SO3 makes continuous quality control for SO3 content incredibly easy for the cement plant, as it avoids labor intensive and costly compressive strength testing.